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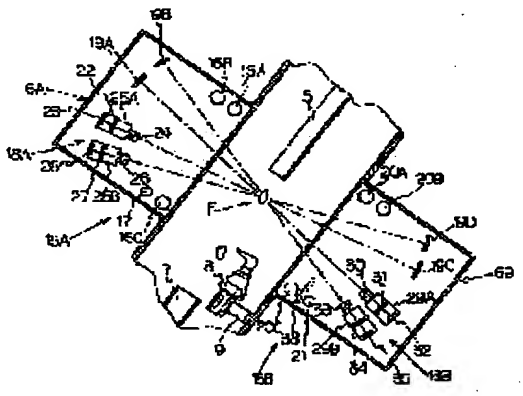
(54) **METHOD FOR SELECTING/SORTING GRAIN BY COLOR AND SELECTING/ SORTING DEVICE**

(57) Abstract:

PROBLEM TO BE SOLVED: To identify grains and foreign matter of a different color from grains of good quality or foreign matter of the same color as grains of good quality or transparent foreign matter and pulverized grains through a single process and select/sort and remove a reject by emitting a third light with a wavelength zone other than a two-wavelength zone to the grains, then detecting the amount of a transmitted light and selecting/sorting and removing grains whose internal quality is different from the grains of good quality.

SOLUTION: A light of a blue light zone from a fluorescent tube 16 is received by a sensor 23 and a light of a red light zone is received by a sensor 35. In addition, a near infrared light from a halogen electric bulb is received by a sensor 28 and a light of a blue light zone from a fluorescent tube 20 is received by a sensor 32. Signal outputs from the sensors 23, 28, 32, 35 are connected to a signal processing means in which the signal outputs are amplified, compared and arithmetically processed and a removal signal is output. This removal signal activates an ejector valve 8 to jet a compressed air from a nozzle orifice. In addition, colored grains and foreign matter of the same color as grains of good quality or transparent foreign matter and pulverized grains are blown off from among the grains of good quality, then are transferred to a conveyance means from a reject delivery aperture to be delivered to the outside of the device. On the other hand, the grains of good quality are recovered by the conveyance means after passing through a receiving trough 7.



LEGAL STATUS

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] ****** which mixes this invention into grain, especially a grain of rice is related with the grain color sorting technique and equipment which carry out the sorting elimination of the defective using an optical means.
[0002]
[Description of the Prior Art] It explains, there being a grain color selector which these people proposed and which was indicated by JP,8-229517,A, for example, and referring to view 5 below as a color selector which carries out the sorting elimination of the tinction grain with which an excellent article and a color are different conventionally using the light of a different two wave region, and an excellent article, the same color or transparent foreign matters (the piece of glass, the piece of plastics, the piece of a metal, the piece of earthenware, piece of porcelain, etc.) from an excellent article,
[0003] A lighting means 51 to irradiate light at the grain which passes a predetermined detection domain in the method of both sides of the grain passage 50, The optical detecting elements 54A and 54B which consist of an optical detection means 52 to receive the reflected light from grain, and the background 53 are opposite-**ed. the lighting means 51 It consists of a halogen lamp 56 which has the fluorescence spool 55 which has a light region, and a near-infrared ray range, and the optical detection means 52 consists of a lens 57, a dichroic mirror 58, light filters 59 and 60, and photo sensors 61 and 62. Moreover, the light filter 59 and the photo sensor 61 are suitable for a light region, and the light filter 60 and the photo sensor 62 are suitable for a near-infrared ray range.
[0004] And while light is irradiated from the lighting means 51 from the supply chute 63 at grain, a tinction grain is discriminated with the light-receiving signal of a photo sensor 61 and a tinction grain is removed by the airstream from a nozzle 64, a foreign matter is discriminated with the light-receiving signal of a photo sensor 62, and a foreign matter is removed by the airstream from a nozzle 64.
[0005] there is ****** (the case where it is one of the unripe grains when a grain of rice is a husked rice, and it is a white rice -- general -- "-- carrying out -- **** -- called ") the interior of whose is ****** in a grain of rice Although the cortex section has the component equivalent to an excellent article while the appearance has the color equivalent to an excellent article, the interior is ******, and since a flavor is also inferior when appearance is bad and moreover carries out cooking rice, since it has the white opaque section, the sorting elimination of the ****** is usually carried out out of the grain of rice as a defective with the tinction grain or the aforementioned foreign matter.
[0006] and in carrying out the sorting elimination of the ****** using the above-mentioned equipment Since the appearance and the cortex section of ****** are the same as that of an excellent article, there is no difference with an excellent article in the amount of reflected lights, as mentioned above, and sorting elimination cannot be carried out as a tinction grain or a foreign matter, After removing a tinction grain and a foreign matter out of a grain of rice beforehand, the fluorescence spool 55 which has the light region of optical detecting-element 54B is erased. A grain of rice after removing a tinction grain and a foreign matter is again supplied to a selector, only the transmitted light from a grain of rice is received by the photo sensor 61 of optical detecting-element 54B, an excellent article and ****** are discriminated with the light income, and the sorting elimination of

the ****** is carried out from the excellent article.
[0007] By the way, while it considers as the technique of carrying out the sorting elimination of all the defectives at once using the above-mentioned equipment, the halogen lamps 56 and 56 of optical detecting-element 54B are erased and the amount of reflected lights of the light and the amount of reflected lights of near-infrared light are detected in optical detecting-element 54A Although it can consider detecting the amount of reflected lights of the light, and the amount of transmitted lights of near-infrared light in optical detecting-element 54B In this case, it became inadequate irradiating of the near-infrared light to the background 53 of optical detecting-element 54B, and an excellent article and ****** had the trouble where fault arose in sorting of a transparent foreign matter.
[0008] Thus, if a grain of rice is supplied again and the sorting elimination of the ****** is not carried out after removing a tinction grain and a foreign matter beforehand in the above-mentioned equipment, an excellent article and a defective cannot be sorted out certainly.
[0009]
[Problem(s) to be Solved by the Invention] Let it be a technical technical probrem that this invention offers the grain color sorting technique and equipment which discriminate the tinction grain and excellent article with which an excellent article and color are different, the same color or a transparent foreign matter, and ****** from an excellent article by one processing in view of the above troubles, and can moreover carry out the sorting elimination of the defective from an excellent article certainly.
[0010]
[Means for Solving the Problem] In order to solve the above-mentioned technical probrem the grain color sorting technique of this invention While the light of a different two wave region is irradiated at grain, the quantity of light of the aforementioned two wave region from this grain is detected. In the grain color sorting technique which discriminates and carries out the sorting elimination of an excellent article, the same color, or the transparent foreign matter while discriminating and carrying out the sorting elimination of the grain and the foreign matter with which an excellent article and color are different While the 3rd light which has wavelength regions other than the aforementioned two wave region in the aforementioned grain was irradiated, the amount of transmitted lights of the 3rd aforementioned light from the aforementioned grain was detected, and the technical means of carrying out the sorting elimination of the grain with which an excellent article and an internal property are different were provided.
[0011] Moreover, the lighting section which irradiates the light of the two wave region which the grain color selector of this invention forms the chute for guiding grain into predetermined grain passage, and is different from this chute to grain, The optical detection means which consists of the light-receiving section which detects the quantity of light of the aforementioned two wave region from the aforementioned grain is opposite-**ed to the method of both sides of the aforementioned grain passage. In the grain color selector which ****ed the ejector which operates with the signal from the control section connecting with the aforementioned light-receiving section in the aforementioned grain passage It forms in the lighting section which irradiates the light of third wavelength region other than this two wave region while the light of the two wave region which is different the account of a front in the lighting section of one aforementioned optical detection means is irradiated. The technical means of forming the light-receiving section of the aforementioned optical detection means of another side in the light-receiving section which detects one quantity of light of the aforementioned two wave region and the quantity of light of the wavelength region of the above third were provided.
[0012] It is good to make light of the aforementioned two wave region into the light and near-infrared light.
[0013] While light of the aforementioned two wave region is made into the light and near-infrared light of an arbitrary wavelength region of the aforementioned light, it is good to make light of the wavelength region of the above third into lights other than the aforementioned arbitrary wavelength region.
[0014]
[Embodiments of the Invention] Hereafter, one example of this invention is explained, referring to a drawing. In drawing 1 , the raw material tank 2 is formed in the 1 side upper part in a frame 1, and

the soffit of the raw material tank 2 is oscillating ****** 3, and is laid on the vibration generator system 4 which consists of vibrator etc. And oscillating ****** 3 is connected to the chute 5 inclined and formed. That is, the upper limit of chute 5 which made the cross section with the V character type is approached and prepared in **** of oscillating ****** 3, and the soffit is made to face among the optical detecting elements 6A and 6B of a couple, forms tubed **** 7 which should receive further the grain of rice which falls from the soffit of chute 5 underneath the chute 5, and connects a conveyance means 13 to discharge an excellent article to the soffit of **** 7. Moreover, in order to remove a defective and a foreign matter out of the grain of rice which falls detection domain F, the nozzle opening of the ejector-mechanism bulb 8 is arranged near detection domain F while falling in **** 7 from the soffit of chute 5. The ejector-mechanism bulb 8 is connected to the compressor outside drawing through the ****** spool 9, the defective exhaust port 10 is formed underneath the ********** bulb 8, and a conveyance means 14 to discharge a defective is connected to the defective exhaust port 10. And the control box 11 and the control panel 12 as a control section are formed in the upper part of a frame 1.

[0015] Drawing 2 is an important section enlarged view of a grain color selector, and explains the optical detecting element 6 hereafter.

[0016] The optical detecting element 6 is constituted from the lighting sections 15A and 15B which irradiate light, the light-receiving sections 18A and 18B which receive the quantity of light from a grain of rice, and the background 19A-19D by the grain of rice which falls predetermined detection domain F, on both sides of detection domain F, counters and is prepared.

[0017] And lighting section 15A of optical detecting-element 6A consists of two or more fluorescence spools 16A, 16B, and 16C which have the wavelength of a blue-glow region and a red colored light region, and a tungsten halogen lamp 17 which has a near-infrared ray range, and lighting section 15B of optical detecting-element 6B consists of two or more fluorescence spools 20A, 20B, and 20C which have the wavelength of a blue-glow region, and a tungsten halogen lamp 21 which has the wavelength of a near-infrared ray range.

[0018] Light-receiving section 18A of optical detecting-element 6A is constituted by two light-receiving meanses 25A and 25B. moreover, light-receiving means 25A It has a condenser lens 24, blue VCF 22, and the sensor 23 that detects the quantity of light of the light which passed this blue VCF 22, and outputs a detecting signal. light-receiving means 25B It has the condenser lens 26, near-infrared-ray VCF 27, and the sensor 28 that detects the quantity of light of the light which passed this near-infrared-ray VCF 27, and outputs a detecting signal.

[0019] Light-receiving section 18B of optical detecting-element 6B is constituted by two light-receiving meanses 29A and 29B. light-receiving means 29A It has a condenser lens 30, blue VCF 31, and the sensor 32 that detects the quantity of light of the light which passed this blue VCF 31, and outputs a detecting signal. light-receiving means 29B It has the condenser lens 33, red VCF 34, and the sensor 35 that detects the quantity of light of the light which passed this red VCF 34, and outputs a detecting signal.

[0020] In addition, what is necessary is just to choose suitably the VCF whose wavelength region is 1400-1600nm considering the VCF whose wavelength region is 600-1100nm as red VCF 34 as near-infrared-ray VCF 27 that what is necessary is just to choose suitably the VCF of the domain whose wavelength region is 400-550nm as blue VCFs 22 and 31.

[0021] Drawing 3 is a block diagram showing the control circuit of this equipment, and the detecting signal of sensors 23, 28, 32, and 35 is connected to the signal-processing means 36 which consists of the OR gate, amplifier, a comparator, an arithmetic circuit, etc. The elimination signal 37 outputted from the signal-processing means 36 is connected to the ejector-mechanism bulb 8, air is blown off from the nozzle opening, and elimination of a defective and a foreign matter is performed.

[0022] Next, the operation in the above-mentioned configuration is explained. If the switch formed in the control panel 12 is turned on, a grain of rice is thrown in in the raw material tank 2 from the chute pipe of the bucket elevator outside drawing and oscillating ****** 3 is driven, a grain of rice falls in chute 5 from the ****, and it will be transported to detection domain F from chute 5 soffit one by one while it carries out the ** style of the **** of chute 5.

[0023] The grain of rice supplied to the detection domain is illuminated by the lighting sections 15A and 15B, and incidence of the light from a grain of rice is carried out to each light-receiving meanses

25 and 29. While the light of the blue region from the fluorescence spool 16 is received by the sensor 23 through the lens 24 and blue VCF 22 as reflected light from a grain of rice, the light of the red colored light region from the fluorescence spool 16 is received by the sensor 35 through the lens 33 and red VCF 34 as transmitted light from a grain of rice.

[0024] Moreover, the near-infrared light from a tungsten halogen lamp 17 is received by the sensor 28 through the lens 26 and near-infrared-ray VCF 27 as reflected light from a grain of rice, and the light of the blue region from the fluorescence spool 20 is received by the sensor 32 through the lens 30 and blue VCF 31 as reflected light from a grain of rice.

[0025] Sensors 23, 28, 32, and 35 are always also supervising the background 19C, 19D, 19A, and 19B which was illuminated with the fluorescence spool 20, the tungsten halogen lamp 21, the fluorescence spool 16, and the fluorescence spool 16, and was adjusted to the same luminosity as an excellent article. Although drawing 4 is the output wave of each sensors 28, 23, 32, and 35 and the elimination signal 37, if the grain which the parvus can discriminate [change of a signal] by the reflected light of light regions, such as a tinction grain and a black stone, if an excellent article passes the wave of sensors 23 and 32 to detection domain F passes, the difference of light and darkness will be sensed greatly.

[0026] Moreover, even if it was the case where change did not arise to the signal of the aforementioned sensors 23 and 32, when a foreign matter discriminable by the reflected light of near-infrared regions, such as a piece of glass, a piece of plastics, and a white stone, passes detection domain F, the wave of a sensor 28 senses the difference of light and darkness greatly.

[0027] Furthermore, even if it is the case where change does not arise to the signal of each aforementioned sensors 23, 32, and 28, into a grain of rice, it is a grain of rice, and has the color equivalent to an excellent article, and ****** which has ****** inside is mixing. Transit of ****** to which the parvus can detect change of a signal by the transmitted light if an excellent article passes the wave of a sensor 35 to detection domain F senses the difference of light and darkness greatly.

[0028] The signal output of each ********** 23, 28, 32, and 35 is connected to the signal-processing means 36, amplification, comparison, and data processing are performed in this signal-processing means 36, and the elimination signal 37 is outputted. The elimination signal 37 operates the ejector-mechanism bulb 8, and the compressed air is injected from the nozzle opening. And the compressed air blows away a tinction grain, an excellent article, the same color or a transparent foreign matter, and ****** out of an excellent article, the tinction grain, the foreign matter, and ****** which were blown away are transported to the conveyance means 14 from the defective exhaust port 10, and are discharged outside the plane, and an excellent article is recovered by the conveyance means 13 through **** 7.

[0029] A dashboard 38 may be formed between a tungsten halogen lamp 21 and detection domain F, and background 19D is illuminated, without the light from a tungsten halogen lamp 21 being irradiated by the direct-detection domain in this case.

[0030] Although the fluorescent lamp 16 is formed in the fluorescence spool which has the wavelength of a blue-glow region and a red colored light region in the gestalt of the above-mentioned implementation Fluorescence spool 16A may be formed between the fluorescence which has the wavelength of a red colored light region, and fluorescence spool 16B and C may be formed in the fluorescence spool which has the wavelength of a blue-glow region. for example, the red light from fluorescence spool 16A Light is received by the sensor 35 as transmitted light from a grain of rice. the blue glow from the fluorescence spools 16B and 16C As reflected light from a grain of rice, light is received by the sensor 23, the near-infrared light from a tungsten halogen lamp 17 is received by the sensor 28 as reflected light from a grain of rice, and ****** can be removed with a tinction grain and a foreign matter. In this configuration, fluorescence spool 20A of optical detection means 6B may be switched off.

[0031] Moreover, while the fluorescence spool 16 of optical detection means 6A is formed in the fluorescence spool which has the wavelength of a blue-glow region altogether Consider light-receiving means 29B as the same configuration as light-receiving means 25B, and background 19B is considered as the same configuration as background 19D. Furthermore, even if it is the case where it considers as the configuration which prepared the light source which has the wavelength of a red

colored light region in one side of the optical detection meanses 6A and 6B, and prepared the light-receiving means and the background of red light in another side of the optical detection meanses 6A and 6B The amount of reflected lights of a blue glow, the amount of reflected lights of near-infrared light, and the amount of transmitted lights of red light can be received simultaneously, the tinction grain and excellent article with which an excellent article and color are different, the same color or a transparent foreign matter, and ****** are discriminated from an excellent article by one processing, and sorting elimination can be carried out from an excellent article at a time.

[0032] In addition, in the gestalt of the above-mentioned implementation, the light used for the identification from an excellent article and ****** should just be light other than the light used for the identification from an excellent article and a tinction grain, and the light used for the identification from an excellent article and a foreign matter that the light used for the identification from an excellent article and a tinction grain should just be the light although a blue glow is used for the identification from an excellent article and a tinction grain and red light is used for the identification from an excellent article and ****** In addition, as light source of the wavelength of a red colored light region, the slit laser light source which has not a fluorescence spool but a 760-800nm wavelength region is sufficient.

[0033]

[Effect of the Invention] While the light of a different two wave region is irradiated at grain, the quantity of light of the aforementioned two wave region from this grain is detected. In the grain color sorting technique which discriminates and carries out the sorting elimination of an excellent article, the same color, or the transparent foreign matter while discriminating and carrying out the sorting elimination of the grain and the foreign matter with which an excellent article and color are different While the 3rd light which has wavelength regions other than the aforementioned two wave region in the aforementioned grain is irradiated Since ****** which has the white opaque section can be discriminated and removed inside by carrying out the sorting elimination of the grain with which the amount of transmitted lights of the 3rd aforementioned light from the aforementioned grain is detected, and an excellent article and an internal property are different, The grain and the foreign matter, the excellent article, the same color or the transparent foreign matter, and ****** from which an excellent article and color are different can be discriminated from an excellent article by one processing, and sorting elimination can be carried out from an excellent article at a time.

[0034] The lighting section which irradiates the light of the two wave region which forms the chute for guiding grain into predetermined grain passage, and is different from this chute to grain, The optical detection means which consists of the light-receiving section which detects the quantity of light of the aforementioned two wave region from the aforementioned grain is opposite-**ed to the method of both sides of the aforementioned grain passage. In the grain color selector which ****ed the ejector which operates with the signal from the control section connecting with the aforementioned light-receiving section in the aforementioned grain passage It forms in the lighting section which irradiates the light of third wavelength region other than this two wave region while the light of the two wave region which is different the account of a front in the lighting section of one aforementioned optical detection means is irradiated. By forming the light-receiving section of the aforementioned optical detection means of another side in the light-receiving section which detects one quantity of light of the aforementioned two wave region, and the quantity of light of the wavelength region of the above third The light-receiving section can detect the amount of transmitted lights of the light of the third wavelength region from grain, and the grain with which an excellent article and an internal property are different can be discriminated. Therefore, the grain and the foreign matter, the excellent article, the same color or the transparent foreign matter, and ****** from which the excellent article contained in the grain from a chute and color differ with the signal from the control section connecting with the light-receiving section can be discriminated from an excellent article by one processing, and the sorting elimination of all the defectives can be certainly carried out from an excellent article by operation of an ejector.

[0035] By making light of the aforementioned two wave region into the light and near-infrared light, the grain and the foreign matter of color which are different from an excellent article in the amount of reflected lights of the light can be discriminated certainly, and an excellent article, the same color, or a transparent foreign matter can be certainly discriminated in the amount of reflected lights of

near-infrared light.

[0036] While light of the aforementioned two wave region is made into the light and near-infrared light of an arbitrary wavelength region of the aforementioned light, by making light of the wavelength region of the above third into lights other than the aforementioned arbitrary wavelength region, the sensor which receives the amount of transmitted lights can be used as the sensor with high photographic sensitivity in a light region, and photographic sensitivity can make a cost low in wavelength regions other than a light region compared with a high sensor.

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] While the light of a different two wave region is irradiated at grain, the quantity of light of the aforementioned two wave region from this grain is detected. In the grain color sorting technique which discriminates and carries out the sorting elimination of an excellent article, the same color, or the transparent foreign matter while discriminating and carrying out the sorting elimination of the grain and the foreign matter with which an excellent article and color are different The grain color sorting technique characterized by carrying out the sorting elimination of the grain with which the amount of transmitted lights of the 3rd aforementioned light from the aforementioned grain is detected, and an excellent article and an internal property are different while the 3rd light which has wavelength regions other than the aforementioned two wave region in the aforementioned grain is irradiated.
[Claim 2] The lighting section which irradiates the light of the two wave region which forms the chute for guiding grain into predetermined grain passage, and is different from this chute to grain, The optical detection means which consists of the light-receiving section which detects the quantity of light of the aforementioned two wave region from the aforementioned grain is opposite-**ed to the method of both sides of the aforementioned grain passage. In the grain color selector which ****ed the ejector which operates with the signal from the control section connecting with the aforementioned light-receiving section in the aforementioned grain passage It forms in the lighting section which irradiates the light of third wavelength region other than this two wave region while the light of the two wave region which is different the account of a front in the lighting section of one aforementioned optical detection means is irradiated. The grain color selector characterized by forming the light-receiving section of the aforementioned optical detection means of another side in the light-receiving section which detects one quantity of light of the aforementioned two wave region, and the quantity of light of the wavelength region of the above third.
[Claim 3] The grain color selector according to claim 2 which becomes considering the light of the aforementioned two wave region as the light and near-infrared light.
[Claim 4] Claim 2 ** which becomes considering the light of the wavelength region of the above third as lights other than the aforementioned arbitrary wavelength region while light of the aforementioned two wave region is made into the light and near-infrared light of an arbitrary wavelength region of the aforementioned light is a grain color selector given in three.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional side elevation of the grain color selector of this invention.
[Drawing 2] It is the important section enlarged view of the grain color selector of this invention.
[Drawing 3] It is the block diagram showing the control circuit of the equipment of this invention.
[Drawing 4] It is explanatory drawing of an output wave in each configuration of the equipment of this invention.
[Drawing 5] It is the important section enlarged view of the conventional grain color selector.
[Description of Notations]
1 Frame
2 Raw Material Tank
3 Oscillating ******
4 Vibration Generator System
5 Chute
6 Optical Detecting Element
7 ****
8 Ejector-Mechanism Bulb
9 ****** Spool
10 Defective Exhaust Port
11 Control Box
12 Control Panel
13 Conveyance Means
14 Conveyance Means
15 Lighting Section
16 Fluorescence Spool
17 Tungsten Halogen Lamp
18 Light-receiving Section
19 Background
20 Fluorescence Spool
21 Tungsten Halogen Lamp
22 Blue VCF
23 Sensor
24 Condenser Lens
25 Light-receiving Means
26 Condenser Lens
27 Near-Infrared-Ray VCF
28 Sensor
29 Light-receiving Means
30 Condenser Lens
31 Blue VCF
32 Sensor
33 Condenser Lens
34 Red VCF

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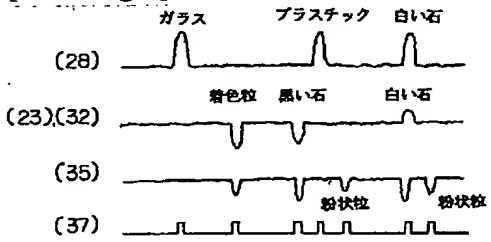
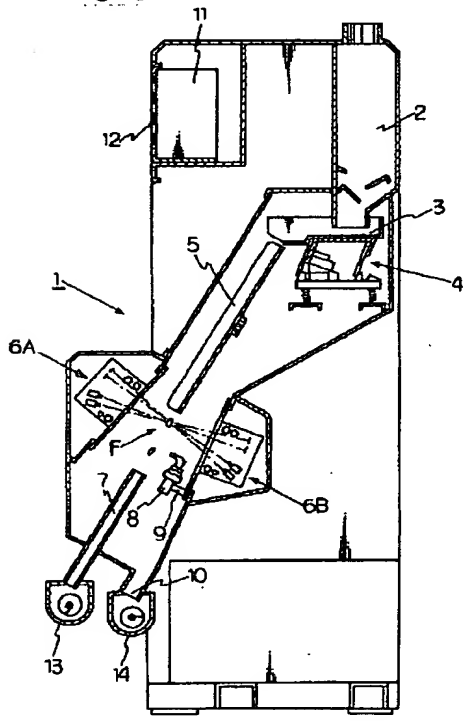
DRAWINGS

[Drawing 4]



[Drawing 1]



[Drawing 2]

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Ｇ０１Ｎ　21/85		Ｇ０１Ｎ　21/85	Ａ

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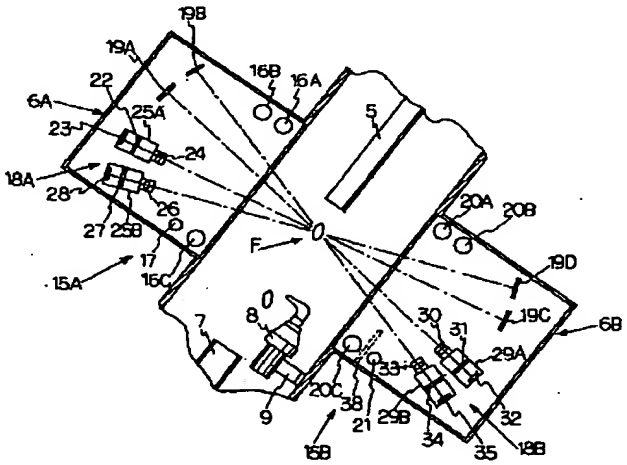
(54)【発明の名称】　穀粒色彩選別方法及び装置

(57)【要約】

【目的】　良品と色彩が異なる着色粒、良品と同色もしくは透明の異物及び粉状粒を良品と識別し、一度に良品から選別除去する。

【構成】　異なる２波長域の光を穀粒に照射するとともに、該穀粒からの前記２波長域の光量を検出し、良品と色彩が異なる穀粒及び異物を識別して選別除去する一方、良品と同色もしくは透明な異物を識別して選別除去する穀粒色彩選別方法において、前記穀粒に前記２波長域以外の波長域を有する第３の光を照射するとともに、前記穀粒からの前記第３の光の透過光量を検出し、良品と内部性質の異なる穀粒を選別除去する。



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【特許請求の範囲】

【請求項１】　異なる２波長域の光を穀粒に照射するとともに、該穀粒からの前記２波長域の光量を検出し、良品と色彩が異なる穀粒及び異物を識別して選別除去する一方、良品と同色もしくは透明な異物を識別して選別除去する穀粒色彩選別方法において、前記穀粒に前記２波長域以外の波長域を有する第３の光を照射するとともに、前記穀粒からの前記第３の光の透過光量を検出し、良品と内部性質の異なる穀粒を選別除去することを特徴とする穀粒色彩選別方法。

【請求項２】　所定の穀粒流路内に穀粒を案内するためのシュートを設け、該シュートからの穀粒に異なる２波長域の光を照射する照明部と、前記穀粒からの前記２波長域の光量を検出する受光部とからなる光学検出手段を前記穀粒流路の両側方に対設し、前記受光部と連絡した制御部からの信号により作動するエジェクタを前記穀粒流路内に臨設した穀粒色彩選別装置において、一方の前記光学検出手段の照明部を、前記異なる２波長域の光を照射するとともに該２波長域以外の第三の波長域の光を照射する照明部に形成し、他方の前記光学検出手段の受光部を、前記２波長域の一方の光量と前記第三の波長域の光量とを検出する受光部に形成したことを特徴とする穀粒色彩選別装置。

【請求項３】　前記２波長域の光を、可視光と近赤外光としてなる請求項２記載の穀粒色彩選別装置。

【請求項４】　前記２波長域の光を、前記可視光の任意波長域の光と近赤外光とするとともに、前記第三の波長域の光を前記任意波長域以外の可視光としてなる請求項２又は３記載の穀粒色彩選別装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、穀粒、特に米粒中に混入する異物又は不良品を光学的手段を用いて選別除去する穀粒色彩選別方法及び装置に関する。

【０００２】

【従来の技術】従来、異なる２波長域の光を用いて、良品と色の異なる着色粒と、良品と同色もしくは透明の異物（ガラス片、プラスチック片、金属片、陶器片、磁器片など）とを良品から選別除去する色彩選別装置としては、本出願人が提案した例えば特開平８－２２９５１７号公報に開示された穀粒色彩選別装置があり、以下図５を参照しながら説明する。

【０００３】穀粒流路５０の両側方には、所定の検出範囲を通過する穀粒に光を照射する照明手段５１と、穀粒からの反射光を受光する光学検出手段５２と、バックグラウンド５３とからなる光学検出部５４Ａ，５４Ｂが対設されており、照明手段５１は、可視光域を有する蛍光管５５と近赤外光域を有するハロゲンランプ５６とから構成され、光学検出手段５２は、レンズ５７、ダイクロイックミラー５８、光学フィルタ５９，６０及び受光セ

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ンサ６１，６２から構成されている。また、光学フィルタ５９及び受光センサ６１は可視光域に適したものであり、光学フィルタ６０及び受光センサ６２は近赤外光域に適したものである。

【０００４】そして、供給シュート６３からの穀粒に照明手段５１から光を照射し、受光センサ６１の受光信号により着色粒を識別し、ノズル６４からの空気流により着色粒は除去されるとともに、受光センサ６２の受光信号により異物を識別し、ノズル６４からの空気流により異物は除去される。

【０００５】米粒にはその内部が粉状質である粉状粒（米粒が玄米である場合には未熟粒の１つであり、白米である場合には一般に「しらた」と呼ばれる）がある。粉状粒はその外観が良品と同等の色を有しているとともに、表層部が良品と同等の成分を有しているものの、内部が粉状質であって白色不透明部を有しているため見た目が悪く、しかも炊飯した場合には食味も劣るため、通常、着色粒や前記異物とともに不良品として米粒中から選別除去されている。

【０００６】そして、上記装置を用いて粉状粒を選別除去する場合には、前述したように粉状粒はその外観及び表層部が良品と同じであり反射光量に良品との差はなく、着色粒や異物として選別除去することができないため、あらかじめ米粒中から着色粒と異物を除去した後、例えば光学検出部５４Ｂの可視光域を有する蛍光管５５を消して、着色粒と異物とを除去した後の米粒を選別装置に再度供給し、光学検出部５４Ｂの受光センサ６１で米粒からの透過光のみを受光し、その受光量により良品と粉状粒とを識別して良品から粉状粒を選別除去している。

【０００７】ところで、上記装置を用いて一度に全ての不良品を選別除去する方法として、光学検出部５４Ｂのハロゲンランプ５６，５６を消し、光学検出部５４Ａにおいて可視光の反射光量と近赤外光の反射光量とを検出するとともに、光学検出部５４Ｂにおいて可視光の反射光量と近赤外光の透過光量とを検出することが考えられるが、この場合、光学検出部５４Ｂのバックグラウンド５３への近赤外光の照射が不十分となり、良品と同色又は透明な異物の選別に不具合が生じるという問題点があった。

【０００８】このように、上記装置においてはあらかじめ着色粒と異物とを除去した後、再度米粒を供給して粉状粒を選別除去しなければ確実に良品と不良品とを選別することはできない。

【０００９】

【発明が解決しようとする課題】本発明は以上のような問題点にかんがみ、良品と色彩が異なる着色粒、良品と同色もしくは透明の異物及び粉状粒を１回の処理で良品と識別し、しかも確実に良品から不良品を選別除去できる穀粒色彩選別方法及び装置を提供することを技術的課

題とする。

【0010】

【課題を解決するための手段】上記課題を解決するため本発明の穀粒色彩選別方法は、異なる2波長域の光を穀粒に照射するとともに、該穀粒からの前記2波長域の光量を検出し、良品と色彩が異なる穀粒及び異物を識別して選別除去する一方、良品と同色もしくは透明な異物を識別して選別除去する穀粒色彩選別方法において、前記穀粒に前記2波長域以外の波長域を有する第3の光を照射するとともに、前記穀粒からの前記第3の光の透過光量を検出し、良品と内部性質の異なる穀粒を選別除去する、という技術的手段を講じた。

【0011】また、本発明の穀粒色彩選別装置は、所定の穀粒流路内に穀粒を案内するためのシュートを設け、該シュートからの穀粒に異なる2波長域の光を照射する照明部と、前記穀粒からの前記2波長域の光量を検出する受光部とからなる光学検出手段を前記穀粒流路の両側方に対設し、前記受光部と連絡した制御部からの信号により作動するエジェクタを前記穀粒流路内に臨設した穀粒色彩選別装置において、一方の前記光学検出手段の照明部を、前記異なる2波長域の光を照射するとともに該2波長域以外の第三の波長域の光を照射する照明部に形成し、他方の前記光学検出手段の受光部を、前記2波長域の一方の光量と前記第三の波長域の光量とを検出する受光部に形成する、という技術的手段を講じた。

【0012】前記2波長域の光を、可視光と近赤外光とするとよい。

【0013】前記2波長域の光を、前記可視光の任意波長域の光と近赤外光とするとともに、前記第三の波長域の光を前記任意波長域以外の可視光とするとよい。

【0014】

【発明の実施の形態】以下、本発明の一実施例を図面を参照しながら説明する。図1において、フレーム1内の一側上部に原料タンク2を設け、原料タンク2の下端は振動供給樋3であって、バイブレータなどからなる振動発生装置4上に載置される。そして、振動供給樋3は、傾斜して設けたシュート5に接続してある。すなわち、横断面をV字型となしたシュート5の上端は、振動供給樋3の樋端に近接して設けられ、その下端は一対の光学検出部6A，6Bの間に臨ませ、さらに、シュート5の下方には、シュート5の下端から落下する米粒を受けるべき筒状の受樋7を設け、受樋7の下端には良品を排出する搬送手段13を連絡する。また、シュート5の下端から受樋7内に落下する間の検出範囲F付近には、検出範囲Fを落下する米粒中から不良品と異物とを除去するため、エジェクターバルブ8のノズル口を配設する。エジェクターバルブ8はエヤー管9を介して図外のコンプレッサーに接続してあり、エジャクターバルブ8の下方には不良品排出口10を設け、不良品排出口10には不良品を排出する搬送手段14を連絡する。そして、フレーム1の上部には制御部としてのコントロールボックス11及び操作パネル12を設ける。

【0015】図2は穀粒色彩選別装置の要部拡大図であり、以下、光学検出部6について説明する。

【0016】光学検出部6は、所定の検出範囲Fを落下する米粒に光を照射する照明部15A，15Bと、米粒からの光量を受光する受光部18A，18Bと、バックグラウンド19A～19Dとから構成され、検出範囲Fを挟んで対向して設けられている。

【0017】そして、光学検出部6Aの照明部15Aは、青色光域と赤色光域の波長を有する複数の蛍光管16A，16B，16Cと、近赤外光域を有するハロゲン電球17とで構成され、光学検出部6Bの照明部15Bは、青色光域の波長を有する複数の蛍光管20A，20B，20Cと、近赤外光域の波長を有するハロゲン電球21とで構成されている。

【0018】また、光学検出部6Aの受光部18Aは2つの受光手段25A，25Bにより構成されており、受光手段25Aは、集光レンズ24と、青色フィルター22と、この青色フィルター22を通過した光の光量を検出して検出信号を出力するセンサー23とを備え、受光手段25Bは、集光レンズ26と、近赤外線フィルター27と、この近赤外線フィルター27を通過した光の光量を検出して検出信号を出力するセンサー28とを備えている。

【0019】光学検出部6Bの受光部18Bは2つの受光手段29A，29Bにより構成されており、受光手段29Aは、集光レンズ30と、青色フィルター31と、この青色フィルター31を通過した光の光量を検出して検出信号を出力するセンサー32とを備え、受光手段29Bは、集光レンズ33と、赤色フィルター34と、この赤色フィルター34を通過した光の光量を検出して検出信号を出力するセンサー35とを備えている。

【0020】なお、青色フィルター22，31としては、波長域が例えば400～550nmの範囲のフィルターを適宜選択すればよく、赤色フィルター34としては波長域が600～1100nmのフィルターを、近赤外線フィルター27としては波長域が1400～1600nmのフィルターを適宜選択すればよい。

【0021】図3は本装置の制御回路を示すブロック図であり、センサー23，28，32，35の検出信号は、ORゲート、増幅器、比較器及び演算回路等からなる信号処理手段36に連絡される。信号処理手段36から出力された除去信号37はエジェクターバルブ8に連絡され、ノズル口より空気を噴出して不良品及び異物の除去が行われる。

【0022】次に上記構成における作用について説明する。操作パネル12に設けたスイッチをONし、図外のバケットエレベータのシュートパイプから原料タンク2内に米粒を投入し、振動供給樋3を駆動すると米粒はそ

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の樋端からシュート５内に落下し、順次、シュート５の樋床を滑流するとともにシュート５下端から検出範囲Ｆに移送される。

【００２３】検出範囲に供給された米粒は照明部１５Ａ，１５Ｂにより照明され、米粒からの光が各々の受光手段２５，２９に入射される。蛍光管１６からの青色域の光は、米粒からの反射光としてレンズ２４及び青色フィルター２２を通ってセンサー２３に受光されるとともに、蛍光管１６からの赤色光域の光は、米粒からの透過光としてレンズ３３及び赤色フィルター３４を通ってセンサー３５に受光される。

【００２４】また、ハロゲン電球１７からの近赤外光は、米粒からの反射光としてレンズ２６及び近赤外線フィルター２７を通ってセンサー２８に受光され、蛍光管２０からの青色域の光は、米粒からの反射光としてレンズ３０及び青色フィルター３１を通ってセンサー３２に受光される。

【００２５】センサー２３，２８，３２，３５は常時、蛍光管２０、ハロゲン電球２１、蛍光管１６及び蛍光管１６により照明され良品と同じ明るさに調整されたバックグラウンド１９Ｃ，１９Ｄ，１９Ａ，１９Ｂも監視している。図４は各センサー２８，２３，３２，３５及び除去信号３７の出力波形であるが、センサー２３，３２の波形は、検出範囲Ｆに良品が通過すると信号の変化が小さいが、着色粒、黒色の石等の可視光域の反射光で識別できる粒子が通過すると大きく明暗の差が感知される。

【００２６】また、前記センサー２３，３２の信号に変化が生じない場合であっても、ガラス片、プラスチック片、白い石等の近赤外域の反射光で識別できる異物が検出範囲Ｆを通過した場合には、センサー２８の波形は大きく明暗の差を感知する。

【００２７】更に、前記各センサー２３，３２，２８の信号に変化が生じない場合であっても、米粒中には、米粒であって良品と同等の色を有しており、内部に粉状質を有している粉状粒が混入している。センサー３５の波形は、検出範囲Ｆに良品が通過すると信号の変化は小さいが、透過光で検出できる粉状粒が通過すると大きく明暗の差が感知される。

【００２８】各センサー－２３，２８，３２，３５の信号出力は、信号処理手段３６に連絡され、この信号処理手段３６において増幅、比較及び演算処理が行われ、除去信号３７が出力される。除去信号３７はエジェクターバルブ８を作動し、ノズル口から圧縮空気が噴射される。そして、圧縮空気は、着色粒、良品と同色もしくは透明の異物及び粉状粒を良品中から吹き飛ばし、吹き飛ばされた着色粒、異物及び粉状粒は不良品排出口１０から搬送手段１４へ移送され機外へ排出され、良品は受樋７を通って搬送手段１３により回収される。

【００２９】ハロゲン電球２１と検出範囲Ｆとの間に仕

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切板３８を設けてもよく、この場合、ハロゲン電球２１からの光は直接検出範囲に照射されることなく、バックグラウンド１９Ｄを照明する。

【００３０】上記実施の形態においては、蛍光灯１６を青色光域と赤色光域の波長を有する蛍光管に形成しているが、例えば、蛍光管１６Ａを赤色光域の波長を有する蛍光間に形成し、蛍光管１６Ｂ，Ｃを青色光域の波長を有する蛍光管に形成してもよく、蛍光管１６Ａからの赤色光は、米粒からの透過光としてセンサー３５により受光され、蛍光管１６Ｂ，１６Ｃからの青色光は、米粒からの反射光としてセンサー２３により受光され、ハロゲン電球１７からの近赤外光は、米粒からの反射光としてセンサー２８に受光され、粉状粒は着色粒及び異物とともに除去可能である。この構成においては、光学検出手段６Ｂの蛍光管２０Ａを消灯する場合もある。

【００３１】また、光学検出手段６Ａの蛍光管１６を全て青色光域の波長を有する蛍光管に形成するとともに、受光手段２９Ｂを受光手段２５Ｂと同様の構成とし、バックグラウンド１９Ｂをバックグラウンド１９Ｄと同様の構成とし、更に、光学検出手段６Ａ，６Ｂの一方に赤色光域の波長を有する光源を設け、光学検出手段６Ａ，６Ｂの他方に赤色光の受光手段及びバックグラウンドを設けた構成とした場合であっても、青色光の反射光量、近赤外光の反射光量及び赤色光の透過光量を同時に受光することができ、良品と色彩が異なる着色粒、良品と同色もしくは透明の異物及び粉状粒を１回の処理で良品と識別し、１度に良品から選別除去できる。

【００３２】なお、上記実施の形態においては、良品と着色粒との識別のために青色光を用い、良品と粉状粒との識別のために赤色光を用いているが、良品と着色粒との識別に用いる光は可視光であればよく、良品と粉状粒との識別に用いる光は、良品と着色粒との識別に用いる光及び、良品と異物との識別に用いる光以外の光であればよい。なお、赤色光域の波長の光源としては、蛍光管ではなく７６０～８００ｎｍの波長域を有するスリットレーザー光源でもよい。

【００３３】

【発明の効果】異なる２波長域の光を穀粒に照射するとともに、該穀粒からの前記２波長域の光量を検出し、良品と色彩が異なる穀粒及び異物を識別して選別除去する一方、良品と同色もしくは透明な異物を識別して選別除去する穀粒色彩選別方法において、前記穀粒に前記２波長域以外の波長域を有する第３の光を照射するとともに、前記穀粒からの前記第３の光の透過光量を検出し、良品と内部性質の異なる穀粒を選別除去することにより、内部に白色不透明部を有する粉状粒を識別して除去することができるため、良品と色彩が異なる穀粒及び異物、良品と同色もしくは透明な異物及び粉状粒を１回の処理で良品と識別し、１度に良品から選別除去することができる。

【００３４】所定の穀粒流路内に穀粒を案内するためのシュートを設け、該シュートからの穀粒に異なる２波長域の光を照射する照明部と、前記穀粒からの前記２波長域の光量を検出する受光部とからなる光学検出手段を前記穀粒流路の両側方に対設し、前記受光部と連絡した制御部からの信号により作動するエジェクタを前記穀粒流路内に臨設した穀粒色彩選別装置において、一方の前記光学検出手段の照明部を、前記異なる２波長域の光を照射するとともに該２波長域以外の第三の波長域の光を照射する照明部に形成し、他方の前記光学検出手段の受光部を、前記２波長域の一方の光量と前記第三の波長域の光量とを検出する受光部に形成することにより、穀粒からの第三の波長域の光の透過光量を受光部により検出することができ、良品と内部性質が異なる穀粒を識別することができる。そのため、受光部と連絡した制御部からの信号により、シュートからの穀粒中に含まれる良品と色彩が異なる穀粒及び異物、良品と同色もしくは透明の異物及び粉状粒を１回の処理で良品と識別し、エジェクタの作動により確実に良品から全ての不良品を選別除去することができる。

【００３５】前記２波長域の光を、可視光と近赤外光とすることにより、可視光の反射光量で良品と異なる色彩の穀粒及び異物を確実に識別することができ、近赤外光の反射光量で良品と同色もしくは透明の異物を確実に識別することができる。

【００３６】前記２波長域の光を、前記可視光の任意波長域の光と近赤外光とするとともに、前記第三の波長域の光を前記任意波長域以外の可視光とすることにより、透過光量を受光するセンサーを可視光域に感度が高いセンサーとすることができ、可視光域以外の波長域に感度が高いセンサーに比べコストを低くすることができる。

【図面の簡単な説明】

【図１】本発明の穀粒色彩選別装置の側断面図である。

【図２】本発明の穀粒色彩選別装置の要部拡大図である。

【図３】本発明の装置の制御回路を示すブロック図である。

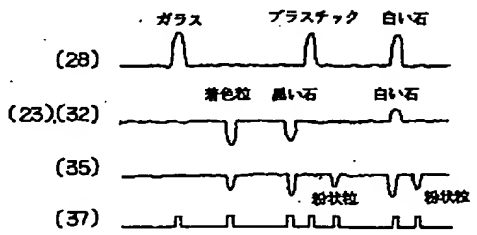
【図４】本発明の装置の各構成における出力波形の説明図である。

【図５】従来の穀粒色彩選別装置の要部拡大図である。

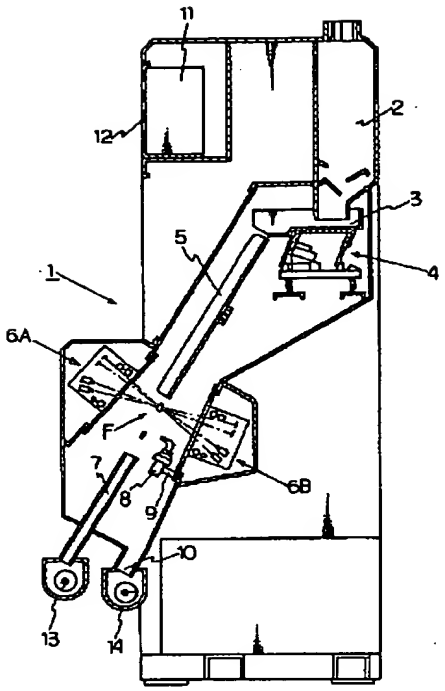
【符号の説明】

１　フレーム
２　原料タンク
３　振動供給樋
４　振動発生装置
５　シュート
６　光学検出部
７　受樋
８　エジェクターバルブ
９　エヤー管
１０　不良品排出口
１１　コントロールボックス
１２　操作パネル
１３　搬送手段
１４　搬送手段
１５　照明部
１６　蛍光管
１７　ハロゲン電球
１８　受光部
１９　バックグラウンド
２０　蛍光管
２１　ハロゲン電球
２２　青色フィルター
２３　センサー
２４　集光レンズ
２５　受光手段
２６　集光レンズ
２７　近赤外線フィルター
２８　センサー
２９　受光手段
３０　集光レンズ
３１　青色フィルター
３２　センサー
３３　集光レンズ
３４　赤色フィルター
３５　センサー
３６　信号処理手段
３７　除去信号
３８　仕切板

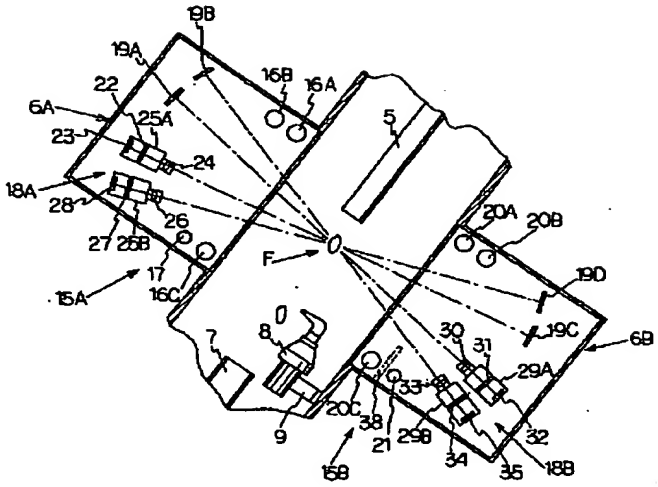
【図４】



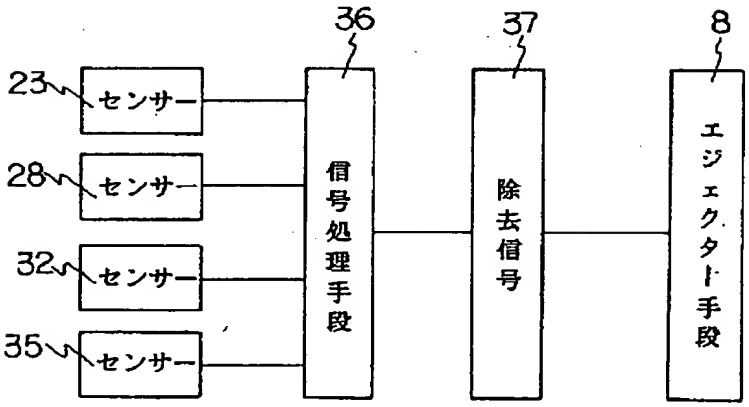
【図１】


11
12
2
3
4
5
1
6A
F
7
8
9
6B
10
13
14

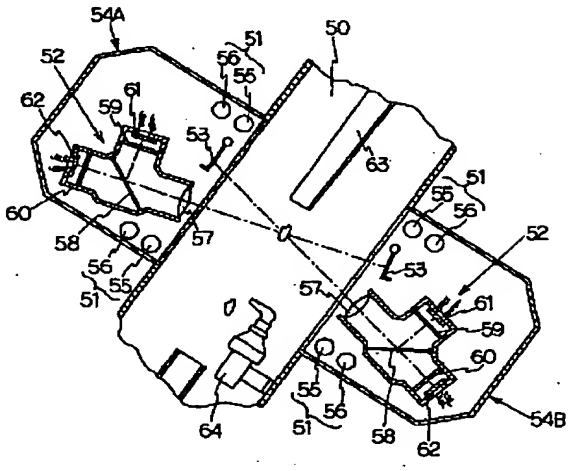
【図２】


19B
19A
16B
16A
22
6A
25A
23
24
18A
28
26
27
25B
17
16C
15A
5
F
20A
20B
19D
19C
6B
7
8
30
31
29A
33
20C
38
21
29B
34
35
32
18B
9
15B

【図３】


36
37
8
23
センサー
28
センサー
32
センサー
35
センサー
信号処理手段
除去信号
エジェクター手段

【図５】


54A
52
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51
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54B
64